

AMENDMENTS TO THE SPECIFICATION

The specification has been amended as follows:

Pages 1-2

The paragraph beginning on page 1, line 18 and ending on page 2, line 1 has been amended as follows:

Exhaust gas purification apparatus for a gasoline engine such as an MPI (Multi Point Injection) engine have been proposed, which oxidize or reduce hazardous substances (carbon monoxide CO, hydrocarbons HC, nitrogen oxides NOx, and so forth) exhausted from the engine, and consequently, change hazardous substances into more harmless substances. In order to particularly reduce, from among the hazardous substances, HC discharged by a ~~great~~large amount upon cold starting of the engine, apparatus have been developed wherein HC is absorbed once into an HC-trap catalyst.

Pages 2-3

The paragraph beginning on page 2, line 12 and ending on page 3, line 2 has been amended as follows:

As shown in FIG. 7, the HC-trap catalyst 2 with a three way function includes an HC absorbent 2a (here, zeolite) formed on an inner peripheral face of a carrier 3, in which a plurality of cell holes 3a are formed, for absorbing HC, and a three way catalyst 2b formed on the HC absorbent 2a for

purifying HC desorbed from the HC absorbent 2a. In such a conventional exhaust gas purification apparatus as just described, particularly upon cold starting of the engine, a ~~great~~large amount of HC included in exhaust gas exhausted from the engine body (engine) 30 is absorbed once into the HC absorbent 2a, and then, when the temperature of the HC absorbent 2a becomes higher than a predetermined temperature (HC desorption starting temperature) and the HC is desorbed from the HC absorbent 2a, the desorbed HC is purified with the three way catalyst 2b. Meanwhile, the other hazardous substances (CO, NOx) than HC are purified with the three way catalyst 2b and the three way catalyst 1.

Page 5

The paragraph at lines 6-9 has been amended as follows:

~~It is an object of the~~The present invention ~~to provide~~
provides an exhaust gas purification apparatus which can efficiently purify HC in exhaust gas of an engine upon cold starting of the engine.

Pages 5-6

The paragraph beginning on page 5, line 10 and ending on page 6, line 1 has been amended as follows:

According to the present invention, there is provided an exhaust gas purification apparatus for an engine, ~~comprising~~

comprising, a catalytic converter provided in an exhausted path of said engine and including a carrier, an HC absorbent carried on the carrier for absorbing HC in exhaust gas of the engine, an HC purifying catalyst carried on the carrier and capable of purifying the HC desorbed from the HC absorbent, and a transition metal carried on the carrier for absorbing CO in the exhaust gas, and a control apparatus for controlling operation of the engine, the control apparatus including HC desorption timing estimation means for estimating a timing at which the HC is desorbed from the HC absorbent and control means for controlling an air fuel ratio upon starting of the engine to a ratio richer than a stoichiometric air fuel ratio to start operation of the engine and changing over the air fuel ratio to a ratio leaner than the stoichiometric air fuel ratio at the timing at which the HC is desorbed based on an output of the HC desorption timing estimation means.

Page 7

The heading at line 14 has been amended as follows:

DETAILED DESCRIPTION OF THE ~~PREFERRED EMBODIMENTS~~PRESENT
INVENTION

The paragraph at lines 15-22 has been amended as follows:

The present invention will now be described in detail with reference to the accompanying drawings showing ~~preferred~~ embodiments thereof. It is to be understood, however, that

the dimensions, materials, shapes, and arrangements of component parts should not be restricted to the following embodiments, but changes within the purview of the appended claims may be made without departing from the true scope.

Pages 8-9

The paragraph beginning on page 8, line 22 and ending on page 9, line 3 has been amended as follows:

~~The present exhaust gas purification apparatus is characterized, in~~ In addition to the configuration described above, ~~in that nickel (Ni) 5 which~~ 5, which is a kind of transition ~~metal is~~ metal, is carried on the three way catalyst 2b. It is to be noted that the transition metal which may be carried on the three way catalyst 2b is not limited to the nickel 5, but cobalt (Co), zinc (Zn), manganese (Mn), iron (Fe), chrome (Cr) and so forth can be used as the transition metal.

Page 9

The paragraph at lines 4-22 has been amended as follows:

Usually, the three way catalyst 2b consists principally of palladium (Pd) or platinum (Pt) although it sometimes contains a ~~very very~~ very small amount of nickel. In contrast, in the present exhaust gas purification apparatus, a required amount of nickel 5, more particularly of 20 to 30 g/L in the form of NiO, is carried on the three way catalyst 2b. The

nickel 5 has a characteristic of absorbing carbon monoxide (CO), and the nickel 5 is carried in the three way catalyst 2b so that a ~~great~~large amount of CO in the exhaust gas can be absorbed. Accordingly, although it is conventionally necessary to use a comparatively large amount of Pd, Pt or the like in order to absorb a ~~great~~large amount of CO, the present apparatus eliminates the necessity but can absorb a large amount of CO by employing nickel 5 which is less expensive than Pd or Pt. The reason why the nickel 5 is used to absorb CO is that it is intended to oxidize (burn) CO to obtain combustion energy and use the combustion energy to heat up the three way catalyst 2b.

Page 10

The paragraph at lines 5-23 has been amended as follows:

In particular, upon starting of the engine 30, the air fuel ratio is first controlled to a rich mode wherein it has a richer value than the stoichiometric air fuel ratio so that the engine 30 operates in a state wherein the amount of oxygen (O_2) is comparatively small. Consequently, CO generated by the engine 30 is absorbed sufficiently into the nickel 5. Then, at a timing at which HC is desorbed from the HC absorbent 2a as a result of heat-up of the HC-trap catalyst 4 with a three way function, the air fuel ratio is changed over from the rich mode to a lean mode wherein it has a leaner value than the stoichiometric air fuel

ratio so that a ~~great~~ large amount of O_2 is introduced into the HC-trap catalyst 4 with a three way function. Consequently, ~~the CO absorbed~~ CO absorbed in the nickel 5 reacts with (oxidizes) the sufficient amount of O_2 to form CO_2 , and therefore, ~~the CO is~~ CO is purified ~~at a stroke~~ at once. Then, the HC-trap catalyst 4 with a three way function is heated up rapidly by the heat of reaction generated at this time.

Page 11

The paragraph at lines 11-18 has been amended as follows:

It is to be noted that lines A, ~~B and C~~ B, and C in FIG. 3 illustrate the temperature variations when the nickel 5 of 10 g/L, 20 g/L and 30 g/L in the form of NiO is carried on the three way catalyst 2b. From this graph, it can be said that, preferably, in order to heat up the HC-trap catalyst 4 with a three way function rapidly, the nickel 5 of approximately 20 g/L to 30 g/L in the form of NiO is carried on the three way catalyst 2b.

Pages 11-12

The paragraph beginning on page 11, line 19 and ending on page 12, line 4 has been amended as follows:

In this manner, if the combustion mode is changed over to the lean mode at a timing at which HC is desorbed from the HC absorbent 2a, then the three way catalyst 2b of the HC-trap catalyst 4 with a three way function can be heated up and

activated rapidly, ~~and the HC~~ and HC desorbed from the HC absorbent 2a can be purified efficiently with the three way catalyst 2b. Incidentally, the HC desorption timing estimation section 6 estimates the desorption timing of HC based on an output of a temperature sensor (high temperature sensor) 8 serving as a temperature detection element for directly detecting the temperature of the HC absorbent 2a or a temperature corresponding to the temperature of the HC absorbent 2a.

Page 12

The paragraph at lines 5-24 has been amended as follows:

It is to be noted that, while, in the present embodiment, the temperature of the HC absorbent 2a is detected directly by means of the temperature sensor 8, it is otherwise possible to detect the temperature of the exhaust path 31 and estimate the temperature of the HC absorbent 2a from the detected temperature information. Also it is possible to arithmetically operate the temperature of the HC absorbent 2a from the elapsed time after starting of the engine 30 or the total fuel injection amount after starting of the engine 30 and estimate the desorption timing based on a result of the arithmetic operation. It is to be noted that, in this instance, it is possible to provide a water temperature sensor 9 serving as a water temperature detection element for

detecting the temperature of cooling water of the engine 30, perform the arithmetic operation described above additionally based on the temperature information from the water temperature sensor ~~9~~and 9, and estimate the desorption timing by means of the HC desorption timing estimation section 6.

Pages 13-14

The paragraph beginning on page 13, line 21 and ending on page 14, line 13, has been amended as follows:

Since the exhaust gas purification apparatus as an embodiment of the present invention has such a configuration as described above, the control of the air fuel ratio upon starting of the engine 30 is performed in the following manner. In particular, referring to FIG. 4, the control section 7 first discriminates at step S10 whether or not starting of the engine 30 is cold starting. If the ~~discrimination~~determination is YES, then the control section 7 sets the combustion mode to the rich mode at step S20 and starts combustion of the engine 30. It is to be noted that the ~~discrimination~~determination of whether or not starting of the engine 30 is cold starting may be performed in the following manner. In particular, for example, the temperature of cooling water of the engine 30 is detected by means of the water temperature sensor 9. When the key switch of the engine 30 is changed over from an off state to an on state, if the

detected value of the water temperature is lower than a predetermined value, then it can be ~~discriminated~~determined that starting of the engine 30 is cold starting.

Page 14

The paragraph at lines 14-24 has been amended as follows:

Then at step S30, the HC desorption timing estimation section 6 estimates the desorption timing of HC, and at step S40, it is ~~discriminated~~determined whether or not an HC desorption starting condition is satisfied. If the ~~discrimination~~determination at step S40 is YES, then the combustion mode is changed over from the rich mode to the lean mode at step S50. It is to be noted that the HC desorption starting condition here is given as a temperature of the HC absorbent 2a. However, it may otherwise be given as an elapsed period of time after starting of the engine 30 or a total fuel injection amount as described hereinabove.

Pages 14-15

The paragraph beginning on page 14, line 25 and ending on page 15, line 8 has been amended as follows:

Then at step S60, it is ~~discriminated~~determined whether or not an HC desorption ending condition is satisfied. If the ~~discrimination~~determination is YES, then the lean mode as the combustion mode is ended and an ordinary operation mode is established at step S70. It is to be noted that the HC

desorption ending condition here is given as a temperature of the HC absorbent 2a similarly to the HC desorption starting condition described above. However, it may otherwise be given as an elapsed period of time after starting of the engine 30 or a total fuel injection amount as described hereinabove.